Claims

1. A process for pyrolysis of feedstock, comprising the following steps:

introducing feedstock into, and moving said feedstock through, a reactor tube; and heating the feedstock within said reactor tube to a sufficient temperature such that pyrolysis occurs,

wherein the feedstock is introduced into the reactor tube from an inner hopper, wherein gases of pyrolysis travel through the feedstock in the inner hopper such that said feed stock in the inner hopper acts as a filler,

wherein heat for heating the feedstock is generated by a heat source selected from the group consisting of: combustion chamber, gases, electric oven, coal, heavy oil, tire crumb, electric tube furnace, microwave, solar, and nuclear.

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2. The process according to claim 1, wherein said feedstock comprises a substance selected from the group consisting of biomass wood chips, newspaper, mixed waste paper, peat, energy crops, agricultural residues, coal, tire chips, plastics, RDF, and other organic matter.

3. The process according to claim 1, wherein the heat generated by the heat source is conducted to the feedstock within the reactor tube through a reactor tube wall.

4. The process according to claim 1, wherein the feedstock is moved through the reactor tube by a rotating auger.

5. The process, according to claim 1, wherein pyrolysis occurs within a temperature range from about 800°C (1650°F) to about 1200°C (2190°F) such that substantially anaerobic gasification occurs.

6. The process according to claim 1, wherein pyrolysis occurs within a temperature

range from about 400°C (752°F) to about 800°C (1472°F) such that liquefaction occurs.

7. The process according to claim 1, further comprising the steps of: introducing feedstock into, and moving said feedstock through, at least one additional reactor tube;

and heating the feedstock within said at least one additional reactor tube to a sufficient temperature such that pyrolysis occurs;

wherein the feedstock is introduced into at least one additional reactor tube from the inner hopper.

8. The process according to claim 1, wherein said reactor tube comprises an exit orifice, feedstock exiting the reactor tube via the exit orifice enters a pressure vessel such that the pressure from the pressure vessel controls the flow of gases of pyrolysis from exiting into the pressure vessel.

9. The process according to claim 1, wherein a gas is injected into the reactor tube.

10. The process according to claim 9, wherein said gas is selected from the group consisting of CO_2, steam, natural gas, oxygen, and air.

11. The process according to claim 4, wherein the auger comprises a hollow shaft having at least one opening, wherein gases of pyrolysis can exit through said hollow shaft.

12. The process according to claim 10, further comprising the step of controlling the flow of the gas into the reactor tube in order to adjust the conversion of char and tar exiting the reactor tube into useful gases and/or liquids.

13. The process according to claim 1, further comprising the step of capturing the feedstock residue exiting the reactor tube, wherein said process is useful for pyrolysis of

feedstock comprising a contaminant.

14. The process according to claim 1, further comprising the step of capturing the feedstock residue exiting the reactor tube, wherein said process is useful for pyrolysis of feedstock used for phytomining.

15. The process according to claim 13, wherein said contaminant is selected from the group consisting of heavy metals, lead, mercury, highly refractory metals, volatile metals, copper, chromium, arsenic, copper chromium arsenate and other toxics.

16. A device for pyrolysis of feedstock, comprising:

a reactor tube within which pyrolysis of feedstock occurs;

a means for moving feedstock through the reactor tube;

a means for heating the feedstock within said reactor tube to a sufficient temperature such that pyrolysis occurs; and

an inner hopper, wherein the feedstock enters the reactor tube from the inner hopper, wherein gases of pyrolysis travel through the feedstock in the inner hopper such that said feedstock in the inner hopper acts as a filter.

17. The device according to claim 16, wherein the means for moving said feedstock through said reactor is a rotating auger.

18. The device according to claim 16, wherein said reactor tube comprises an exit orifice, wherein the feedstock residue exiting the exit orifice enters a pressure vessel, wherein the pressure from the pressure vessel controls the flow of gases exiting the exit orifice.

19. The device according to claim 16, wherein the auger comprises a hollow shaft having at least one opening, wherein the gases of pyrolysis can exit through said hollow shaft.

20. The device according to claim 18, further comprising a means for injecting a gas into the exit orifice of the reactor tube.

21. The device according to claim 20, wherein said gas is selected from the group consisting of carbon dioxide, steam, natural gas, oxygen, and air.

22. The device according to claim 16, further comprising:

a means for capturing the feedstock residue exiting the reactor tube, wherein said device is useful for pyrolysis of feedstock containing contaminants.

23. The device according to claim 16, further comprising:

a means for capturing the feedstock residue exiting the reactor tube, wherein said device is useful for phytomining.

24. The device according to claim 19, comprising a means whereby a portion of the pyrolysis gases or external gases are injected into a lower end of the hollow shaft to hasten the transport of condensable gases to an external condenser liquid separator.

25. A method of pyrolysis of feedstock containing at least one contaminant using indirectly heated gasification, comprising the following steps:

moving feedstock containing at least one contaminant through a reactor tube; and

heating the feedstock within said reactor tube to a sufficient temperature such that pyrolysis occurs,

wherein low oxygen conditions of pyrolysis leads to lower containment of the at least one contaminant in the gaseous output and higher capture and concentration of the at least

one contaminant in the feedstock residue.

26. The method according to claim 25, wherein said at least one contaminant is selected from the group consisting of heavy metals, lead, mercury, refractory metals, volatile metals, copper chromium arsenate, copper, chromium, arsenic and other toxics.

27. The method according to claim 25, further comprising the step of scrubbing gas output from the pyrolysis to remove volatile metals from the gas output.

28. The method according to claim 25, wherein low oxygen conditions of pyrolysis leads to essentially anaerobic pyrolysis, wherein said essentially anaerobic pyrolysis lowers the formation of volatile metallic oxides and promotes metallic deposition in the feedstock residue.

29. The method according to claim 25, wherein said method is used for disposal of plant matter used in phytoremediation.

30. The method according to claim 25, wherein the biomass is introduced into the reactor tube from an inner hopper, and wherein gases of pyrolysis travel through biomass in the inner hopper such that said biomass in the inner hopper acts as a filter.

31. A method for recovery of a substance residing in plant matter used in phytoremediation, comprising the following steps:

moving plant matter used in phytoremediation through a reactor tube; heating the plant matter within said reactor tube to a sufficient temperature such that pyrolysis occurs; and capturing plant matter residue exiting the reactor tube,

wherein a substance residing in the plant matter is recovered in the captured plant matter residue.

32. A method for recovering of a substance residing in plant matter used in phytomining, comprising the following steps:

moving the plant matter used in phytomining through a reactor tube; heating the plant matter within said reactor tube to a sufficient temperature such that pyrolysis occurs; and capturing plant matter residue exiting the reactor tube,

wherein a substance residing in the plant matter is recovered in the captured plant matter residue.

33. A process for pyrolysis of feedstock, comprising the following steps:

introducing feedstock into, and moving said feedstock through, a reactor tube; and heating the feedstock within said reactor tube to a sufficient temperature such that pyrolysis occurs.

34. The process, according to claim 33, further comprising the step of introducing a gas into the reactor tube.

35. The process, according to claim 34, wherein the gas is selected from the group consisting of: CO_2, steam, natural gas, oxygen, and air.

36. The process, according to claim 33, wherein the reactor tube comprises an exit orifice, feedstock exiting the reactor tube via the exit orifice enters a pressure vessel such that the pressure from the pressure vessel controls the flow of gases of pyrolysis exiting into the pressure vessel.